Technology Readiness Assessment

PEO/SYSCOM Commanders’ Conference
DSMC, Ft. Belvoir, Virginia
November 20, 2002

Overview of Session
-Briefers-

- Technology Readiness Level Policy and Process Background
  - Joanne Spriggs, Office of the Director, Defense Research and Engineering (Plans and Programs)

- Technology Readiness Examples and Lessons Learned
  - Jack Taylor, Office of the Deputy Under Secretary of Defense (Science and Technology)

PURPOSE

Interim DOD 5000 still requires:

- Technology Readiness Assessments for critical technologies prior to MS B and C decisions.
    - Technology Readiness Levels (or some equivalent assessment) will be used.
    - ACAT ID & 1AM Program Only
- Independent Readiness Assessments, if required
- Process for conducting TRAs is found in the guidebook
    - Technology readiness assessments shall be conducted by the Services and Agencies to determine technical maturity and examine-
    - Program concepts
    - Technology requirements
    - Demonstrated technology capabilities
- Assessments will be evaluated by the DDR&E and findings forwarded to the OIPT and DAB

National Defense Authorization Act for Fiscal Year 2002, Conference Report. Section 804

- For each of the calendar years 2002 through 2005, the Secretary of Defense is required to report to Congress on the implementation of DoD policy regarding technology maturity at the initiation of MDAPs. According to Sec. 804 of the NDAA for Fiscal Year 2002, Conference Report, the reports must ;
  - identify each case in which a major defense acquisition program entered system development and demonstration [i.e., passed MS B] during the preceding calendar year and into which key technology has been incorporated that does not meet the technological maturity requirement … [i.e., that technology must have been demonstrated in a relevant environment (or, preferably, in an operational environment) to be considered mature enough to use for product development in systems integration (from Sec. 804, subsection (a))] and provide a justification for why such technology was incorporated; and
  - identify any determination of technological maturity with which the DUSD(S&T) did not concur and explain how the issue has been or will be resolved.

THE 5000 MODEL

Technology Opportunities & User Needs (BA 1 & 2)

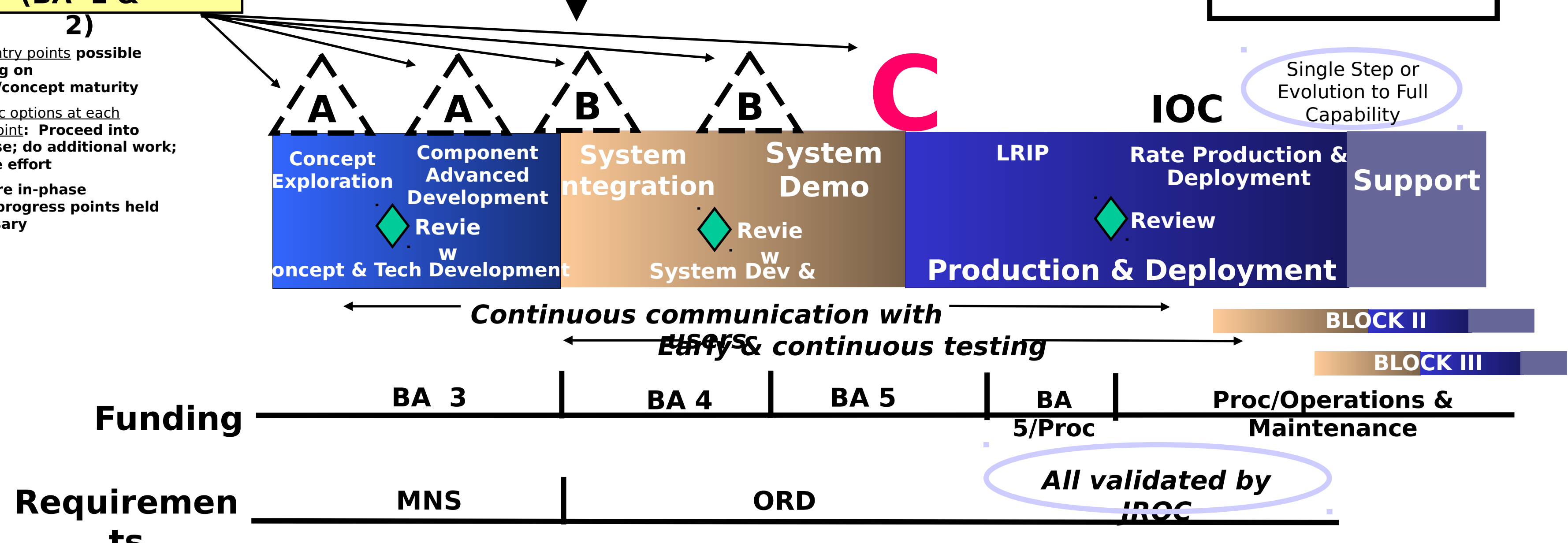
- Multiple entry points **possible depending on technical/concept maturity**
- Three basic options at each decision point**: Proceed into next phase; do additional work; terminate effort**
- Reviews **are in-phase decision/progress points held as necessary**

Program Outyear Funding

MS C EXIT CRITERIA

- ☑ ***Demonstrated system***
- ☑ ***Approved ORD & assured interoperability***
- ☑ ***Affordability assessment***
- ☑ ***Strategy in place for evolutionary approach, production readiness, and supportability***

- MS A**: Analyze concepts**
- MS B**: Begin development**
- MS C**:** *Commitment* **to rapid acquisition.**



Concept Exploration

- Paper studies of alternative concepts for meeting a mission
- Exit criteria: Specific concept to be pursued & technology exists.

Component Advanced Development

- Development of subsystems/components that must be demonstrated before integration into a system
- Concept/tech demonstration of new system concepts
- Exit criteria: System architecture & technology mature.

System Integration

- System integration of demonstrated subsystems and components
- Reduction of integration risk
- Exit criterion: System demonstration in a relevant environment (e.g., first flight).

System Demonstration

- Complete development
- Demo engineering development models
- Combined DT/OT
- Exit criterion: System demonstration in an operational environment.

LRIP

- IOT&E, LFT&E of prod-rep articles
- Create manufacturing capability
- LRIP
- Exit criterion: B-LRIP report.

Rate Prod & Deployment

- Full rate production
- Deployment of system

Deliver Advanced Technology Faster

DOD 5000 Model

- ***Technology opportunity and mission need present -*** *before entering acquisition process*
- ***Multiple process paths -*** *not just one way of entering systems acquisition and commercial products allow later entry*
- ***Evolutionary acquisition -*** *based on time-phased requirements - preferred (but not only approach)*
- ***Technology development separated from systems integration -*** *achieve proven technology before beginning systems-level work at Milest*
- ***"LRIP" more important Departmental commitment -*** *than "Full Rate*
- ***"Entrance criteria" met -*** *before entering next phase*

Technology Readiness Level Approach IPT - Background

- In April 2001, the Defense Science & Technology Advisory Group (DSTAG) recommended establishment of a TRL IPT to develop a framework and guidelines for consistent implementation.

- A follow on IPT was formed, May 2002 to respond to a Business Initiative Council recommendation on streamlining the TRA process

- Products from both IPTs include:
  - High Level Technology Readiness Assessment Process
  - Clarification of the Technology Readiness Level Definition
  - Recommended changes to the FMR and Guidebook
  - Development of a Technology Maturity Agreement (TMA)
    - Improve communications between S&T and Acquisition, especially during identification of critical technologies
    - Eliminate unnecessary reviews by having up front agreements on which, if any, critical technologies require more extensive reviews

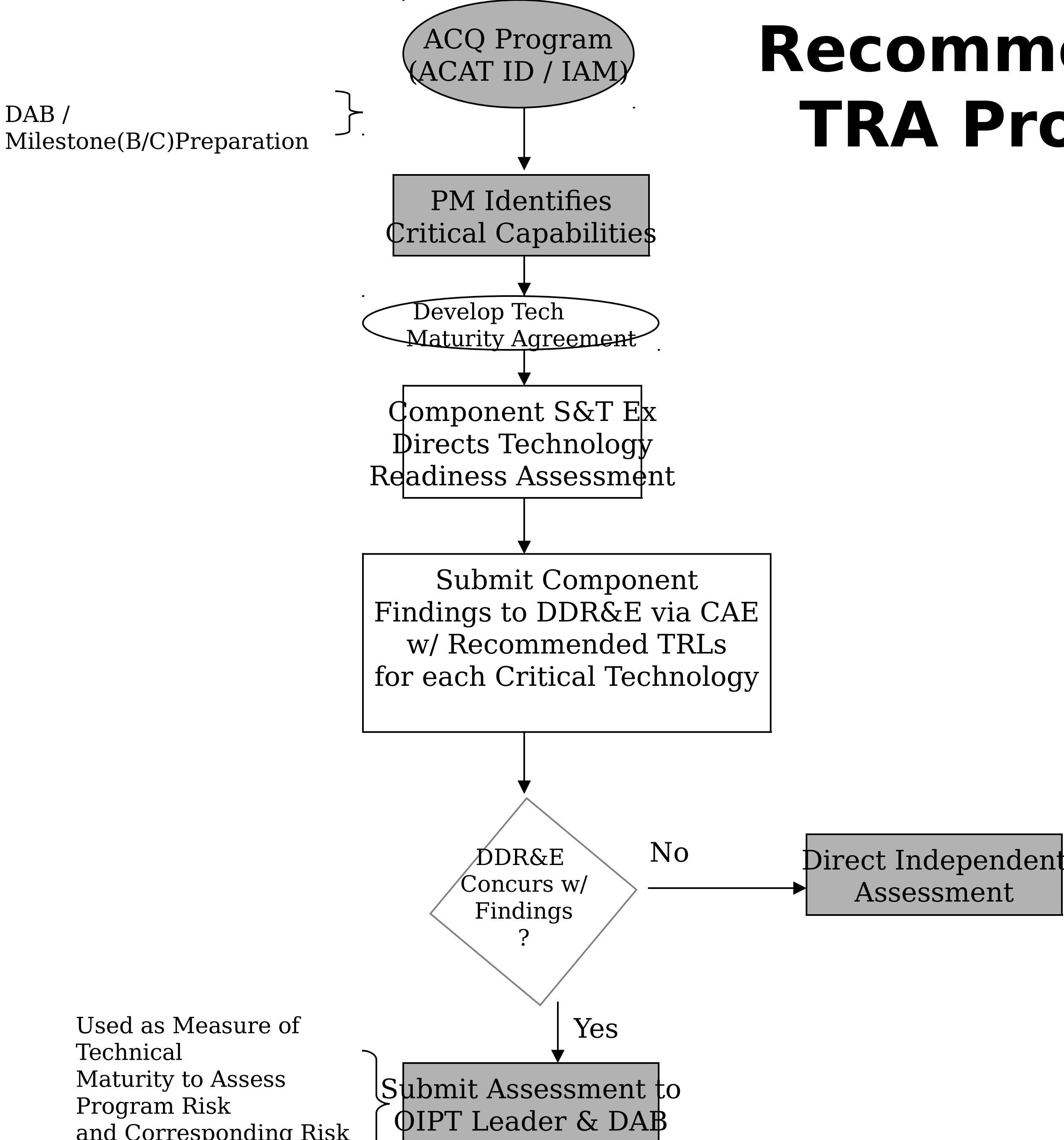
Technology Maturity

Technology Title: Inertial Sensors

POC
Name: John Doe
Phone #: XXX-YYY-ZZZZ

Attributes	Objectives					
	Best Estimated Need	Current	Program Mid-Point Status	Program Mid-Point Risk	Program End Status	Program End Risk
Performance						
Rate Gyro drift	10^{0}/hr	500^{0}/hr	200^{0}/hr	L	50^{0}/hr	H
Accelerometer Dyn. Range	1E+07	1E+03	1E+05	L	1E+06	H
Physical						
Gyro size	2 cu.in.	4 cu.in.	3 cu.in.	M	3 cu.in.	M
Environmental						
Temperature Max/Min.	-25 - 115^{0}C	RM	RM - 100^{0}C	L	0 - 115^{0}C	L
G-Load	1000	[illegible]0	100		500	
Vibrations (Power spectrum)	Unknown	Untested	Untested		50 Spectrum Test	
Programmatic						
Test Environment	Field Test	Lab	Lab		Simulated F	
Unit Cost (By calculation)	$3K/unit	$15K/unit	$15K/unit		$5K/un	
Overall TRL Level	NA	3	4		5	

Recommended TRA Process



Technical Readiness Levels

- **TRL definition used from GAO Report NSIAD-99-162 Best Practices; see "www.gao.gov"**

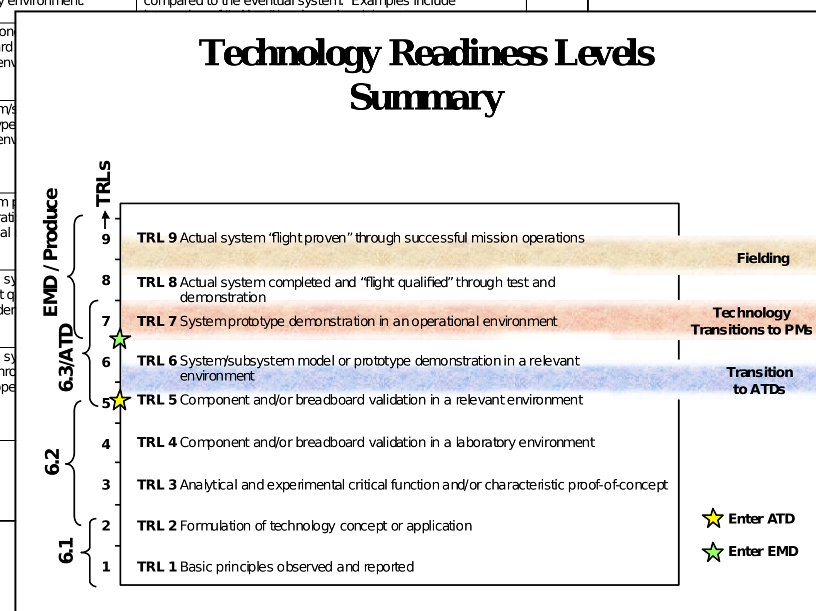
- **Applied logical standard for transition; for MS B: TRL 7, 8, or 9**

Extract from GAO Report NSIAD-99-162 Best Practices; see "www.gao.gov"

Appendix I

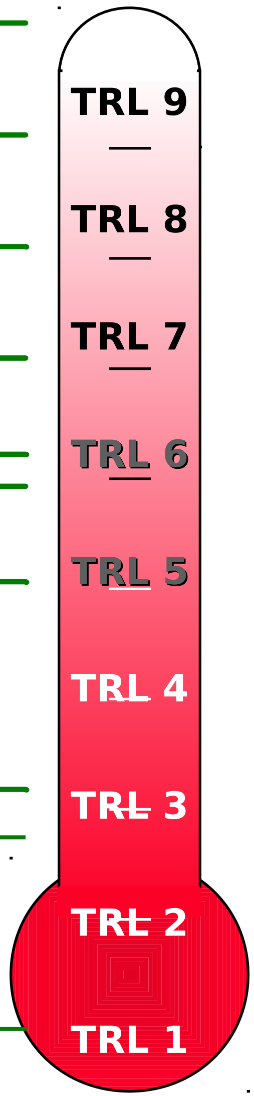
Technology Readiness Levels and Their Definitions

Technology Readiness Level	Description
1. Basic principles observed and reported.	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties.
2. Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative and there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.
3. Analytical and experimental critical function and/or characteristic proof of concept.	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
4. Component and/or breadboard validation in laboratory environment.	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared to the eventual system. Examples include
5. Compon breadboard relevant env	
6. System/s or prototype relevant env	
7. System demonstrati operational	
8. Actual sy and "flight q test and der	
9. Actual sy proven" thro mission ope	



Measuring Technology Maturity

Technology Readiness Levels



System Test, Launch & Operations	TRL 9	Actual system "flight proven" through successful mission operations
System/Subsystem Development	TRL 8	Actual system completed and "flight qualified" through test and demonstration
	TRL 7	System prototype demonstration in a operational environment
Technology Demonstration	TRL 6	System/subsystem model or prototype demonstration in a relevant environment
Technology Development	TRL 5	Component and/or breadboard validation in relevant environment
	TRL 4	Component and/or breadboard validation in laboratory environment
Research to Prove Feasibility	TRL 3	Analytical and experimental critical function and/or characteristic proof-of-concept
Basic Technology Research	TRL 2	Technology concept and/or application formulated
	TRL 1	Basic principles observed and reported

Clarification of TRL Definitions

- **BREADBOARD:** Integrated components that provide a representation of a system/subsystem and which can be used to determine concept feasibility and to develop technical data. Typically configured for laboratory use to demonstrate the technical principles of immediate interest. May resemble final system/subsystem in function only.
- **"HIGH FIDELITY":** Addresses form, fit and function. High fidelity laboratory environment would involve testing with equipment that can simulate and validate all system specifications within a laboratory setting.
- **"LOW FIDELITY":** A representative of the component or system that has limited ability to provide anything but first order information about the end product. Low fidelity assessments are used to provide trend analysis.
- **MODEL:** A reduced scale, functional form of a system, near or at operational specification. Models will be sufficiently hardened to allow demonstration of the technical and operational capabilities required of the final system.
- **OPERATIONAL ENVIRONMENT**: Environment that addresses all of the operational requirements and specifications required of the final system to include platform/packaging.
- **PROTOTYPE:** The first early representation of the system which offers the expected functionality and performance expected of the final implementation. Prototypes will be sufficiently hardened to allow demonstration of the technical and operational capabilities required of the final system.
- **RELEVANT ENVIRONMENT:** Testing environment that simulates the key aspects of the operational environment.
- **SIMULATED OPERATIONAL ENVIRONMENTAL**: Environment that can simulate all of the operational requirements and specifications required of the final system or a simulated environment that allows for testing of a virtual prototype to determine whether it meets the operational requirements and specifications of the final system.

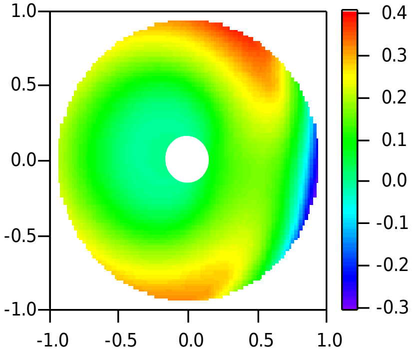
CURRENT ACTIVITIES

- DAU Distance Learning Module under development
- The DUSD(S&T) has prepared a "Technology Readiness Assessment Desk Book"
  - "How to" manual for execution of TRA duties
  - Useful guide and reference for service action officers of Acquisition Executives, S&T Executives and Programs
  - Regular Updates to reflect changes to 5000 Series

EXAMPLES / LESSONS LEARNED

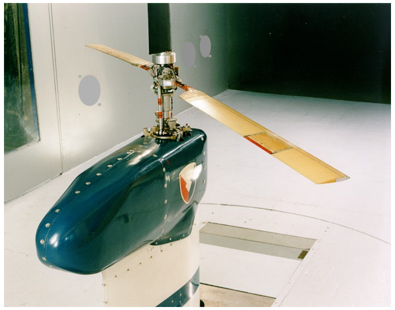
The S&T Continuum

6.1 Basic Research



Research at Universities and Labs involving basic research, mathmatical, simulation for concept formulation

6.2 Applied Research



Research at Universities, Labs, and Contractors experimental research, for proof-of-concept

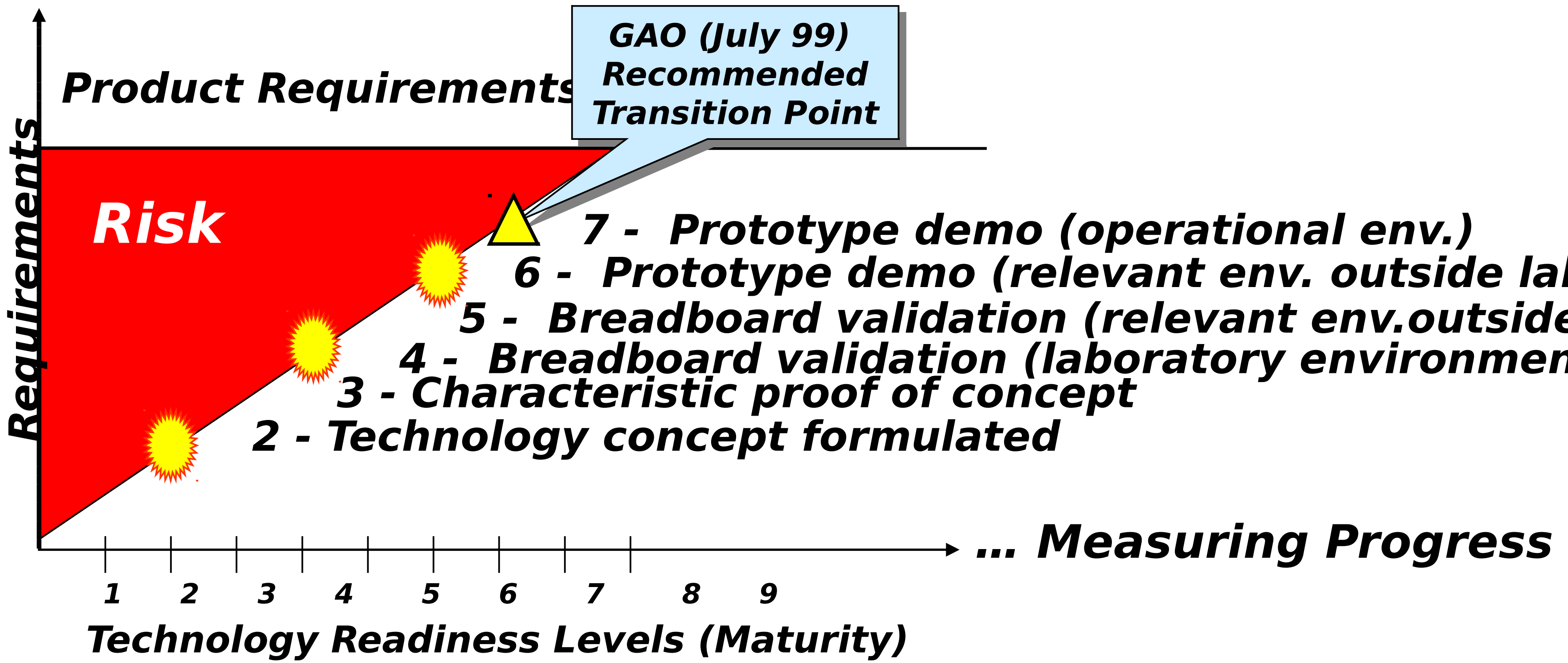
6.3 Advanced Research

Research at Labs and Contractors brassboard/breadboard validation

6.4 Pre-Production

Research at Contractors prototype demonstration and validation

Technology Readiness Levels
… Metrics for Risk Management

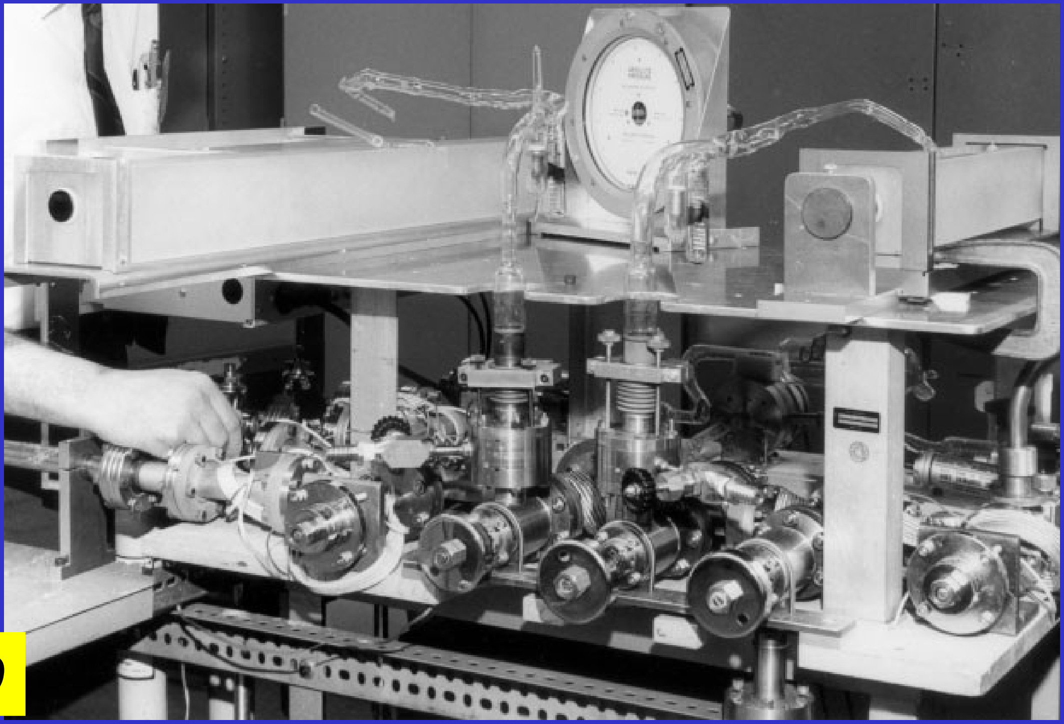


Readiness Decisions for Transformation

Technology Readiness Example
Missiles

Level	Technology Readiness	Example – HG1700 Inertial Measurement Unit Guided Multiple Launch Rocket System (GMLRS)
1	Basic Principles observed and reported.	**Basic research** – Invention of Gas Laser
2	Technology concept and/or application formulated.	**Basic research** – Invention of Ring Laser. Theoretical description of Ring Laser Gyro.

Laser Researc h Facility



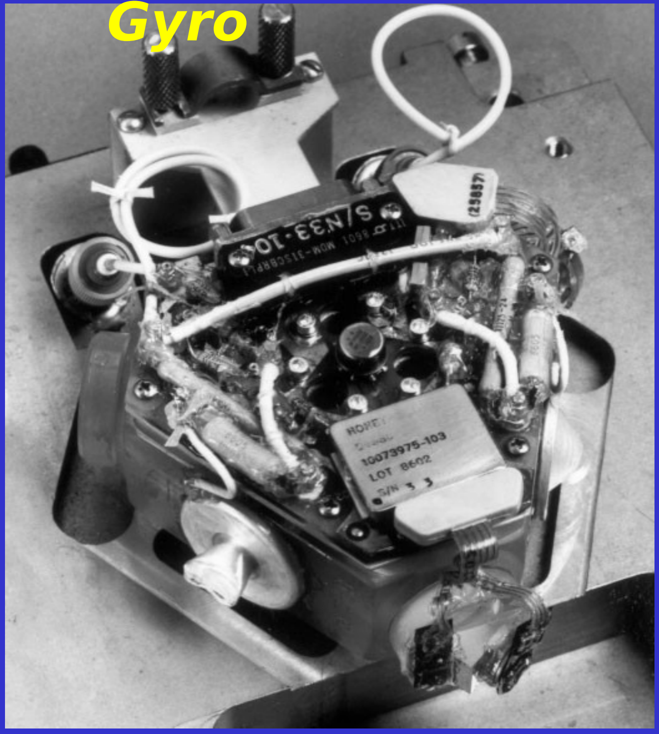
circa 1960

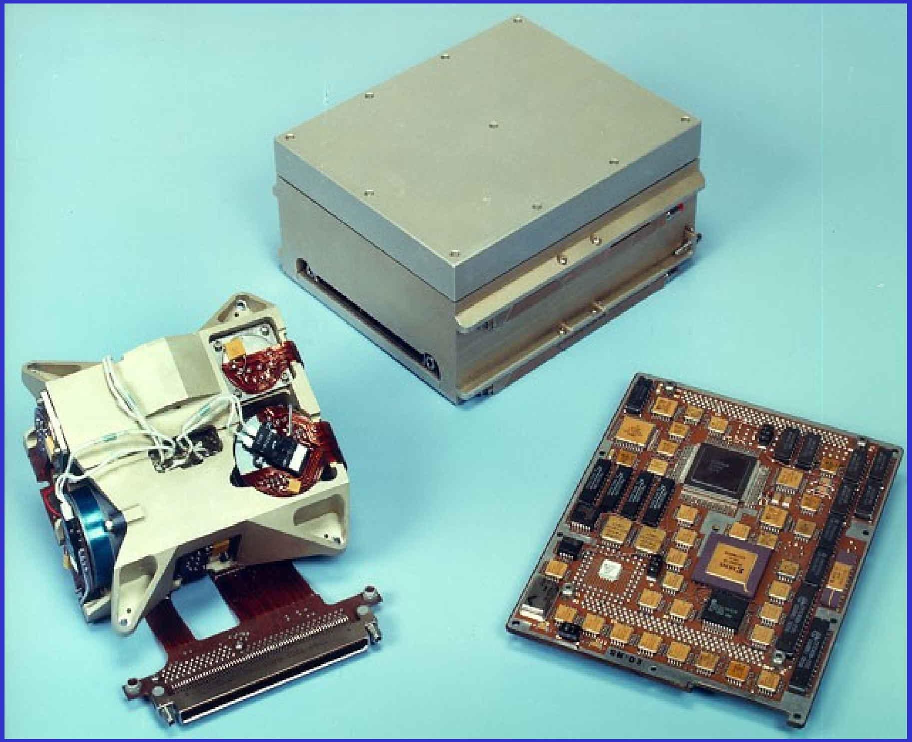
Technology Readiness Example
Missile

Level	Technology Readiness	Example – HG1700 Inertial Measurement Unit Guided Multiple Launch Rocket System (GMLRS)
3	Analytical and experimental critical function and/or characteristic proof of concept.	**Applied research** – Demonstration of Ring Laser as a rate sensor

Ring Laser Gyro

1975





HG1108 Inertial Measurement Unit

circa 1990

Technology Readiness Example
Missiles

Level	Technology Readiness	Example – HG1700 Inertial Measurement Unit Guided Multiple Launch Rocket System (GMLRS)
4	Component and/or breadboard validation in laboratory environment.	**Applied research** – Demonstration of Ring Laser Gyro (RLG)-based Inertial Measurement Unit (IMU) operation under temperature, shock, vibration, and g-loading

Science & Technology Objective

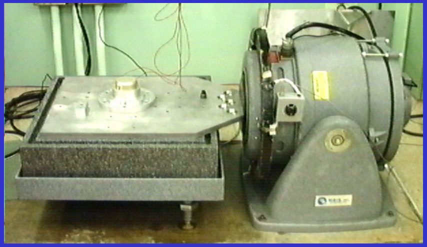
1992-1994

Temperature Chamber

Indexing Table

Rate Table

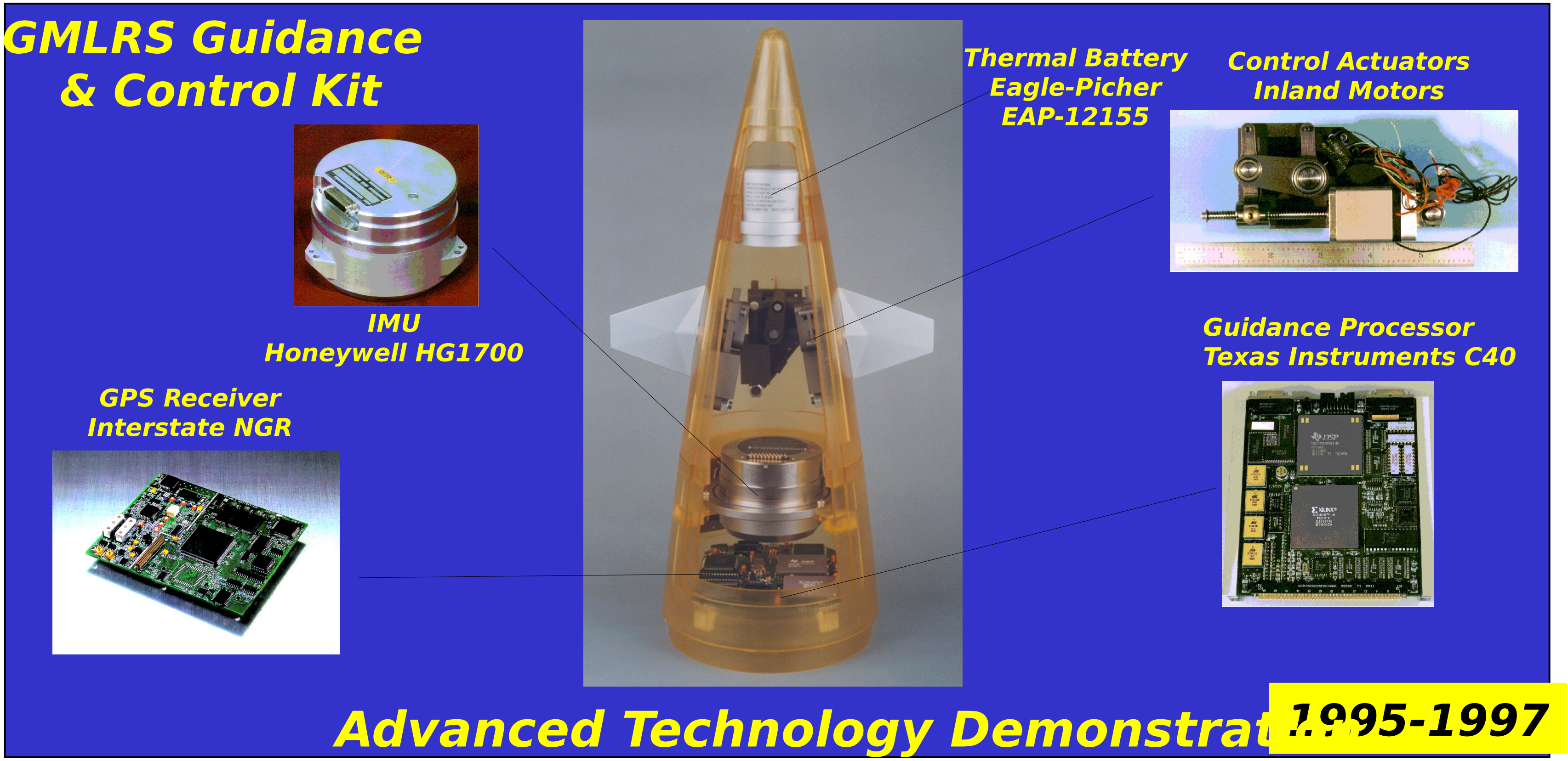
Centrifuge



Vibration Table

Technology Readiness Example
Missiles

Level	Technology Readiness	Example – HG1700 Inertial Measurement Unit Guided Multiple Launch Rocket System (GMLRS)
5	Component and/or breadboard validation in relevant environment.	**Advanced Technology Demonstration** – Demonstration of HG1700-based guidance set components (IMU, GPS receiver, control system, flight computer) in a high-fidelity hardware-in-the-loop facility

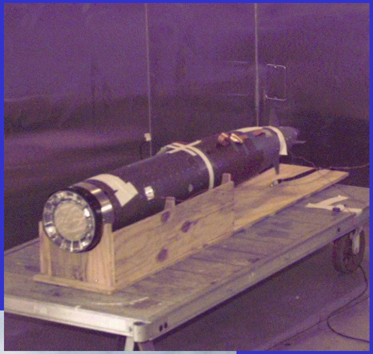


Technology Readiness Example
Missiles

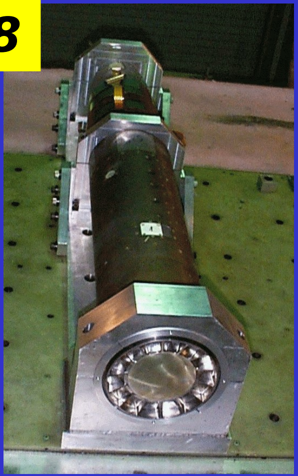
Level	Technology Readiness	Example – HG1700 Inertial Measurement Unit Guided Multiple Launch Rocket System (GMLRS)
6	System/subsystem model or prototype demonstrated in a relevant environment.	**Advanced Technology Demonstration** – Demonstration of actual flight-ready HG1700-based guidance set in a high-fidelity hardware-in-the-loop facility and under expected levels of shock, vibration, altitude and temperature

Advanced Technology Demonstration 1997-1998

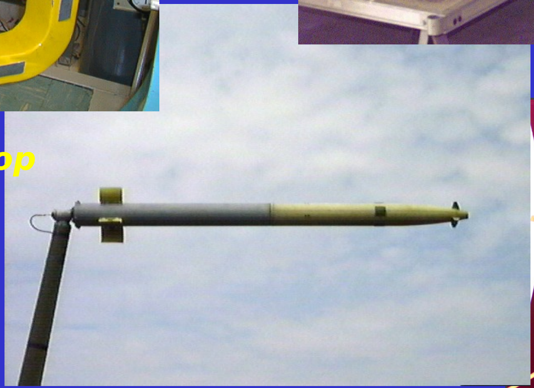
Hardware-in-the-loop



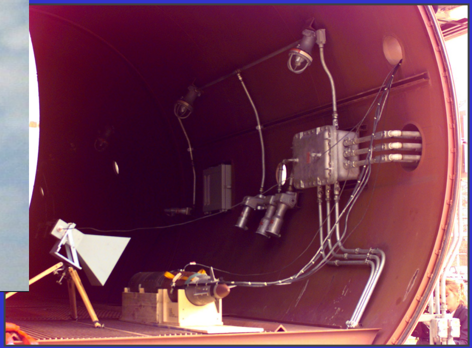
Temperature Test



Vibration Test



Live-sky Testing



Altitude Test

Technology Readiness Example
Missiles

Level	Technology Readiness	Example – HG1700 Inertial Measurement Unit Guided Multiple Launch Rocket System (GMLRS)
7	System prototype demonstrated in an operational environment.	**Advanced Technology Demonstration** of actual Guided MLRS missile in a flight test sequence from an operational launcher. Successful operation in multiple flight demonstrations

Advanced Technology Demonstrat

Completed 1999

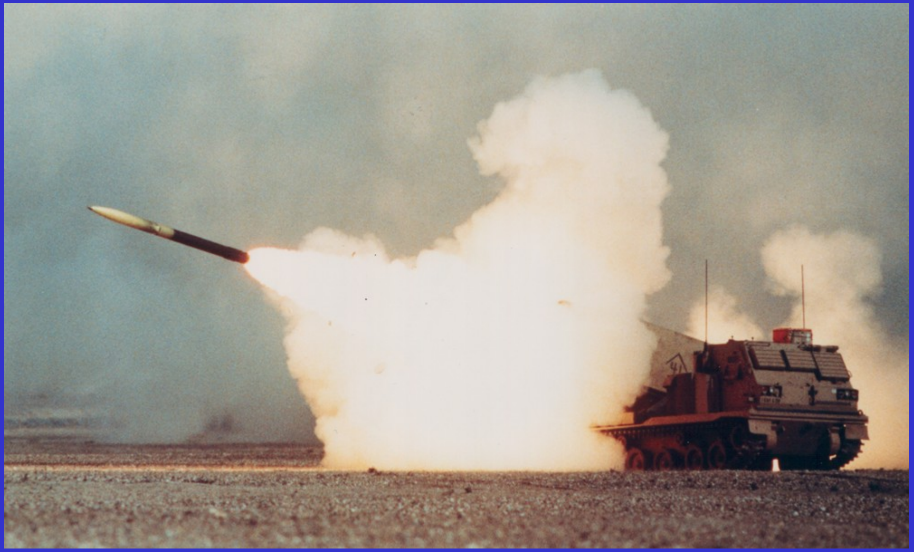
February 11 1999

GPS-aided IMU Flight (2m miss at 49 km range)

Technology Readiness Example
Missiles

Level	Technology Readiness	Example – HG1700 Inertial Measurement Unit Guided Multiple Launch Rocket System (GMLRS)
8	Actual system completed and "flight qualified" through test and demonstration.	**System Development & Demonstration/Low Rate Initial Production** – Developmental Test and Evaluation of GMLRS in its final form under mission conditions.
9	Actual system "flight proven" through successful mission operations.	**Production** – Operational Test and Evaluation of GMLRS by the soldier, airman, or seaman.

SDD 1999-2002



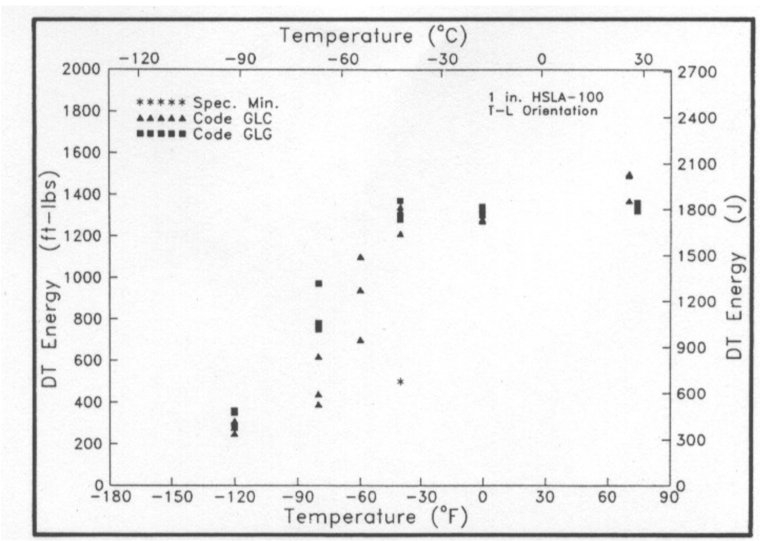
LRIP March 2003

Production March 2005

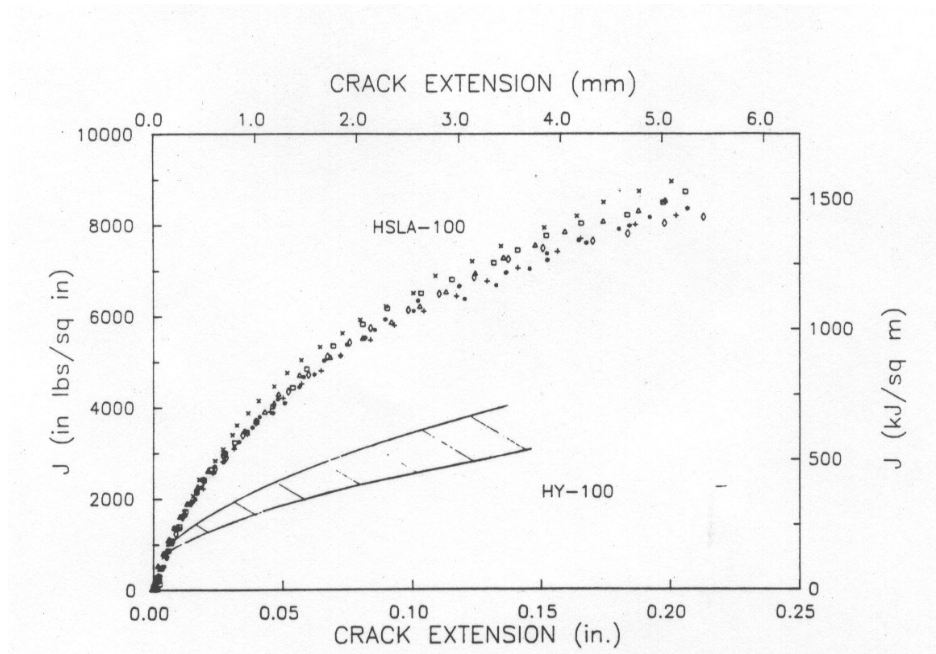
Technology Readiness Example

Ship Steel

Level	Technology Readiness	Example – HSLA-100 Steel for Aircraft Carrier Structure.
4	Component and/or breadboard validation in laboratory environment.	**Applied research** – Weldability testing demonstrated that HSLA-100 was more resistant to hydrogen cracking than HY-100



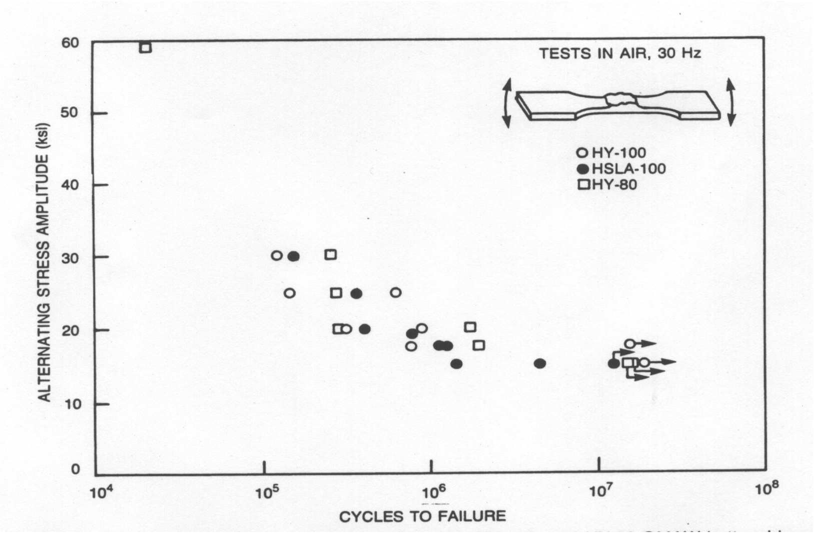
Dynamic Tear Test Results for HSLA-100 Steel Plates



Fracture Toughness Test Results of HSLA-100 and HY-10

Technology Readiness Example
Ship Steel

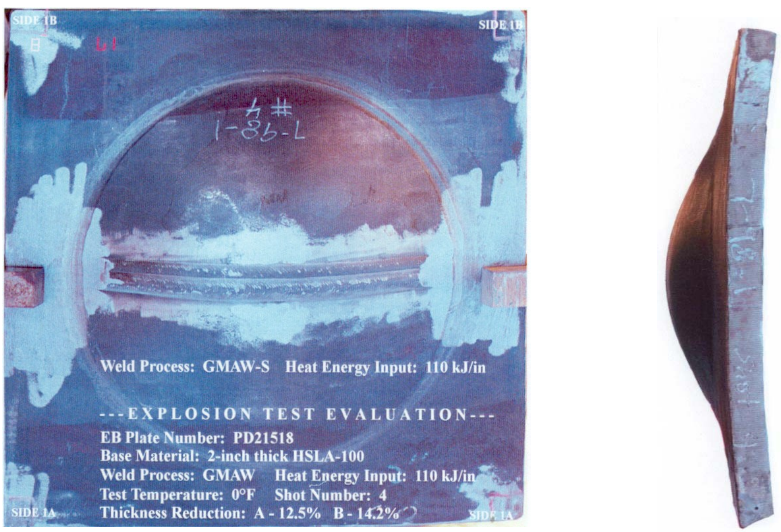
Level	Technology Readiness	Example – HSLA – 100 Steel for Aircraft Carrier Structure.
5	Component and/or breadboard validation in relevant environment.	**Simulation testing – Weldability, fracture toughness, ballistic protection, fatigue, and corrosion properties demonstrated to meet requirements.**



Fatigue Test Results for HSLA-100, HY-100, and HY-80 Steel Weldments

Technology Readiness Example
Ship Steel

Level	Technology Readiness	Example - HSLA – 100 Steel for Aircraft Carrier Structure.
6	System/subsystem model or prototype demonstrated in a relevant environment.	**Model/Prototype Tests** - NAVSEA initiated projects to evaluate the weldability of HSLA-100 steel under various preheat conditions in a production environment. Explosion bulge and crack starter explosion bulge tests of 2-inch thick weldments of production plates were successfully conducted.



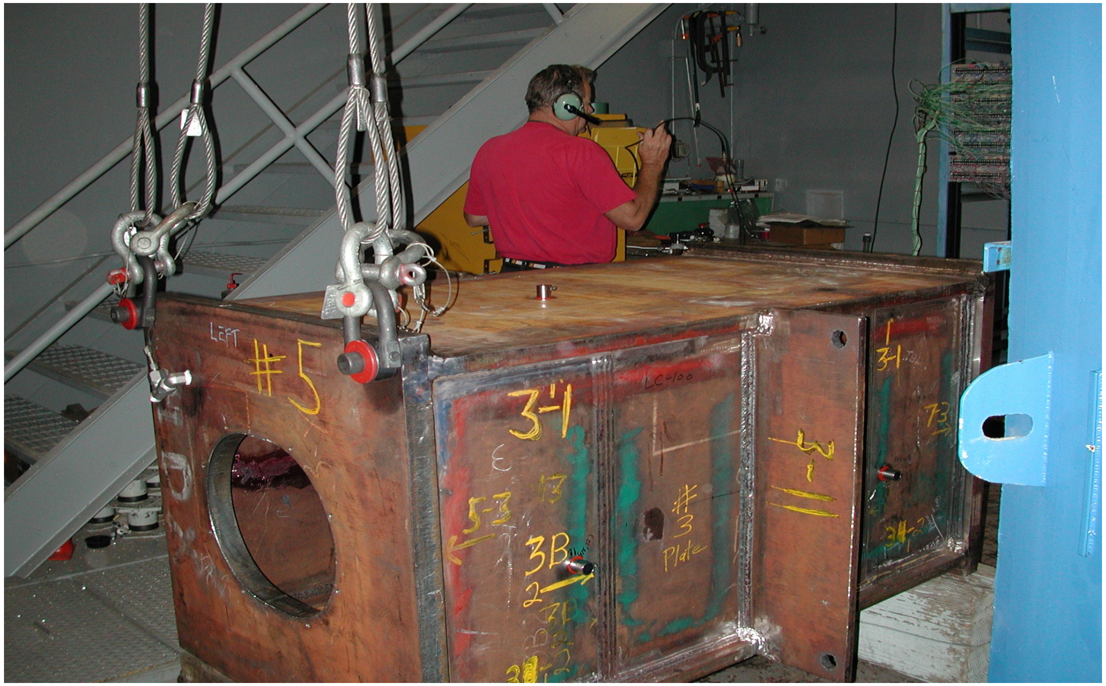
Explosion Bulge Test of HSLA-100 2-inch Thick Weldment

Fragment Penetration Resistance HSLA-100 Test Weldment

Technology Readiness Example

Ship Steel

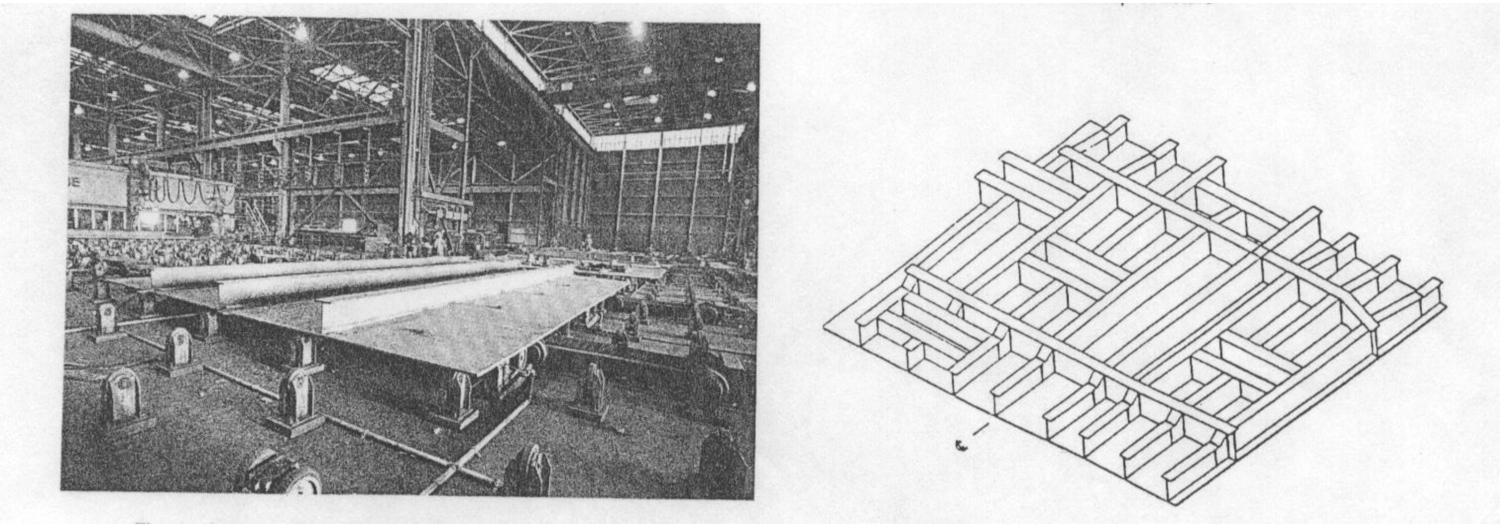
Level	Technology Readiness	Example – HSLA 100 Steel for Aircraft Carrier Structure.
7	System prototype demonstrated in an operational environment.	Holding bulkhead panel models, foundation models, and a full-scale foundation were fabricated and evaluated. Satisfactory structural performance demonstrated. The structures were subjected to a series of underwater explosion (UNDEX) shock tests, and met performance expectations.



HSLA-100 Steel/LC-100 Weld Metal
Box-Tank Fatigue Model
Overall View of Model Exterior/End Hatch Open

Technology Readiness Example
Ship Steel

Level	Technology Readiness	Example – HSLA –100 Steel for Aircraft Carrier Structure.
8	Actual system completed and "flight qualified" through test and demonstration.	Technology Demonstrated In Operation -- In 1989, NAVSEA certified HSLA-100 steel for surface ship construction in thicknesses up to 4 inches. At that time, the *USS JOHN C. STENNIS* (CVN 74) was approved, Fabrication and operation satisfactory.



CVN 74 HSLA-100 Steel Main Deck Panel Fabrication

Technology Readiness Example
Ship Steel

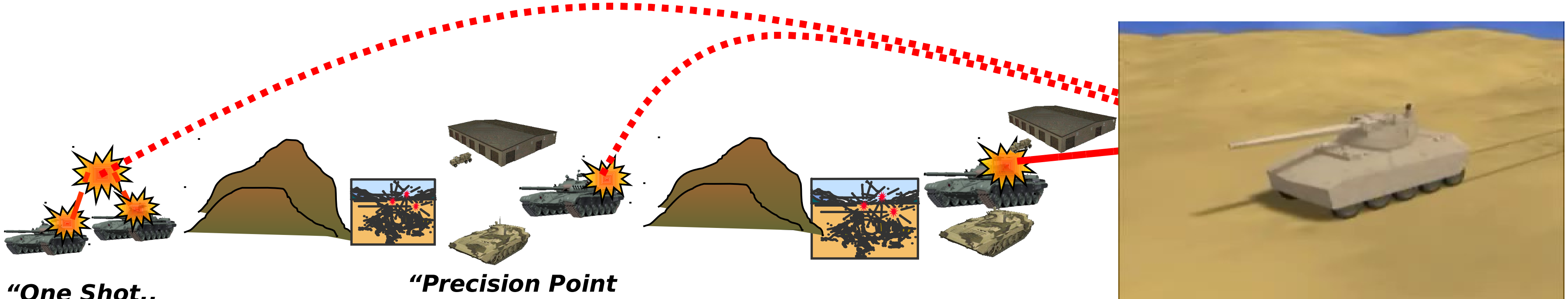
Level	Technology Readiness	Example – HSLA – 100 Steel for Aircraft Carrier Structure.
9	Actual system "flight proven" through successful mission operations.	**Production & In-service Implementation** – Based upon CVN experience, HSLA – 100 was used on CVN 75, and 76, and is planned for CVN 78.

Ship Class	Vessels	LTons
CVN 68	CVN 74	2,080
	CVN 75	11,600
	CVN 76	12,500
	CVN 77	12,500
LHD 1	LHD 5	1,180
	LHD 6	1,200

HSLA – 100 Steel Useage

Multi-Role Armament & Ammunition ATD - Army Example

Objective: Demonstrate compact, direct/indirect fire armament system module capable of rapid lethality against the full spectrum of threats at 0-50km range.



NLOS 4-50KM ***BLOS 2-12km*** ***LOS 0-4Km***

Pacing Technologies:

Cannon -

- **Recoil Mitigation**

Munitions -

- **Electro-Thermal-Chemical Propulsion**
- **Seeker/Guidance & Control**
- **Multi-Mode Warhead**

Warfighter Payoffs:

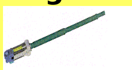
- **Heavy Force Lethality with a 105mm**
  - **> Multi-range - LOS, BLOS, & NLOS**
  - **> Multi-Threat Capable**
- **Reduced logistic footprint**
  - **> High number of stowed rounds**

A Lightweight Armament System For Dominating the Red Zone and Beyond

Multi-Role Armament & Ammunition ATD

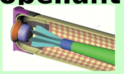
FY01	FY02	FY03	FY04	FY05	FY06	FY07

TRL=4
Recoil Mitigation Demo



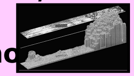
METRICS: Cannon
- **50% reduced recoil force w/Fire-out-of-battery modified M35 cannon w/ETC ignition**

TRL=4
ETC Propellant Demo



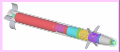
METRICS:
Sub Scale firings of Gen II. Model to validate launch velocity. Full Scale Firing With Adv JA2. Validate integration

TRL=4
Seeker/G&C Acq Demo



METRICS:
- **$P_{acq/Enc}$ to 8km via CFT Demo**

TRL=5
Seeker/G&C High-g Demo

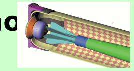


METRIC:
- **MP-ERM:**
  - **18k g's air gun test**
- **Cargo:**
  - **20k g's air gun test**

TRL=5
Multi-Mode WHD

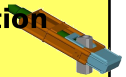
METRIC:
- **Shaped Charge**
  - **L/D=1 (vs 1.7)**
- **EFP**
  - **25% increase in armor penetration**

TRL=5
Propulsion Demo



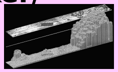
METRICS:
Fire Full Scale Case Telescoped Ammo, Demo M829A2 + 20% performance

TRL=5
Recoil Mitigation Demo



METRICS:
- **<80K lbs hardstand firing of KE slugs**

TRL=6
Seeker/ G&C



METRIC:
- **$P_{acq/Enc}$ via Integ Projectile Guide to Hit gun launch to 10km**

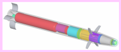
TRL=6
Multi-Mode WHD

METRIC:
- **Integrated WHD demo of 3 lethality modes**

TRL=7
Systems Level Live fire demo of Ammo Suite

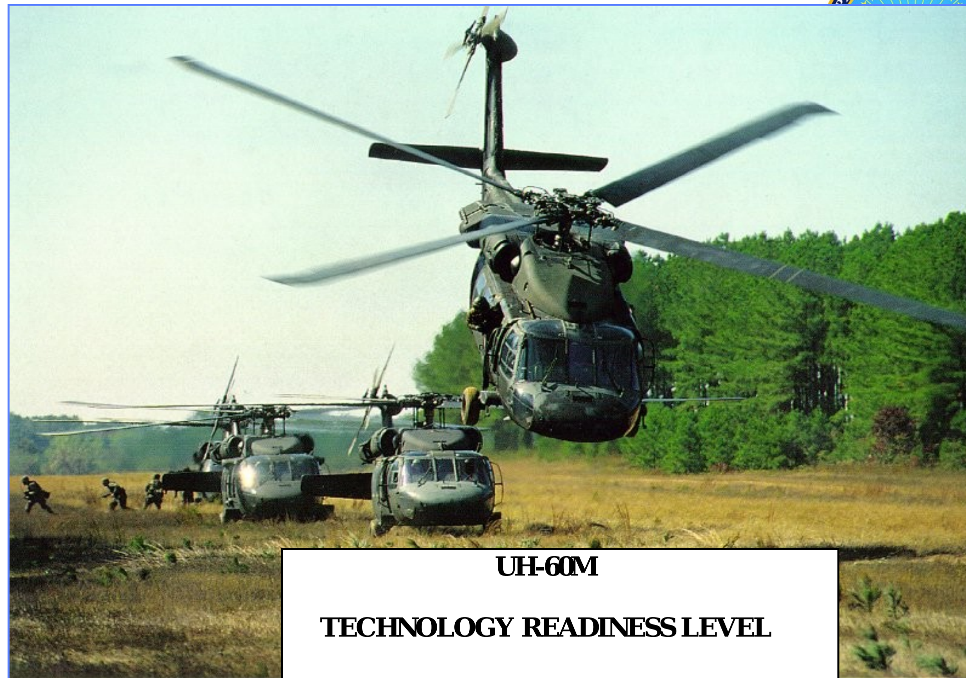
METRICS:
- **Turret integrated on candidate vehicle**

TRL=6
Seeker/ G&C



METRIC:
- **50-150m CEP to 50km**
- **Ambient Temp functionality**

UH-60 Black Hawk Technical Readiness Level Assessment
(Army Example)



UH-60M

TECHNOLOGY READINESS LEVEL

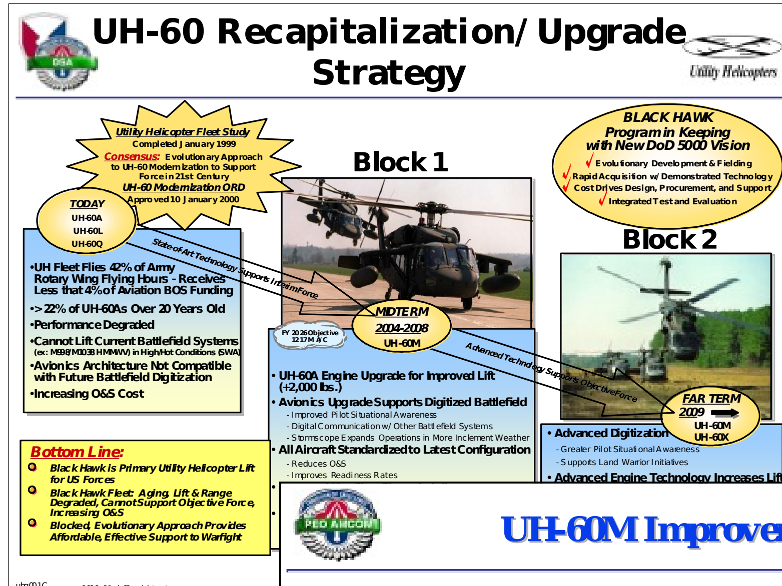
ASSESSMENT

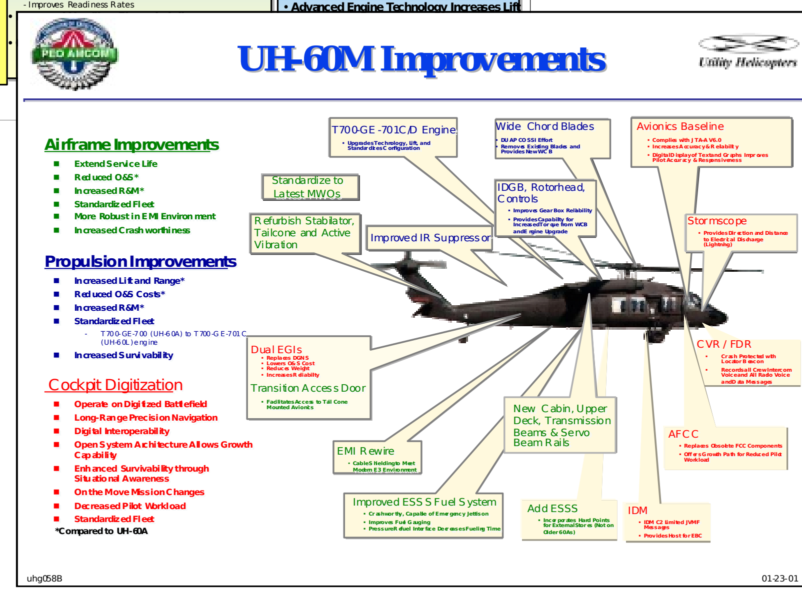
Utility Helicopters

6 March 2001

UH-60M Program

- **UH-60M program is Block 1 of the Recapitalization/ Upgrade of the Army's utility fleet**
- **The Block 1 consists of the application of existing engines, drive train, rotor blades and avionics.**





Guidance

- **To PM:**
  - **Report to ASA(ALT) using existing formats**
  - **Use KPP and WBS**
  - **Define TRL for UH-60M**
  - **Use crosswalk matrix**

Key Performance Parameters

Utility Helicopters

CRITERIA	THRESHOLD	OBJECTIVE
External Load	- Block 1 – Transport	- Block 1 & Block 2 –
Interoperability		

Tota

0009_01uh60qchirt.prt

ATTACHMENT ONE
UH-60M Work Breakdown Structure

WBS LEVEL	DESCRIPTION
1	UH-60M
1.1	Air Vehicle
1.1.1	Air Frame
1.1.1.1	Fuselage
1.1.1.2	Landing Gear
1.1.1.3	Transmission
1.1.1.4	Life Support/Environmental Systems
1.1.1.5	Flight Controls
1.1.1.6	Secondary Power Systems
1.1.1.7	Electrical System Integration
1.1.1.8	Hoist/Cargo System
1.1.1.9	Propulsion Systems
1.1.1.A	Rotor Systems
1.1.2	Communications/Identification
1.1.2.1	Intercom
1.1.2.2	Radio Systems
1.1.2.3	IFF Transducer
1.1.2.4	Communication Security
1.1.2.5	Improved Data Modem (IDM)
1.1.2.6	VHF-FM Radio
1.1.2.7	UHF-AM Radio
1.1.2.8	HF Radio
1.1.2.9	VHF-AM Radio
1.1.2.A	Emergency Control Panel
1.1.3	Navigation/Guidance
1.1.3.1	Radar Navigation
1.1.3.2	Tacan Navigation Set
1.1.3.3	VORS/ILS Navigation
1.1.3.4	Electronic Altimeter Set
1.1.3.5	INS
1.1.3.6	Stormscope
1.1.3.7	Low Freq Auto Direction Finder System
1.1.3.8	Personnel Locator System
1.1.3.9	GPS
1.1.4	Automatic Flight Control System
1.1.4.1	AFCS Avionics
1.1.4.2	AFCS Servos

Army Approval Process

- **Initial brief by PM to Director for Technology**
- **Report approved by PM and submitted to ASA(ALT)**
- **Approval by DAS(R&T) and forward to DUSD(S&T)**
- **DUSD(S&T) concurrence and forward to IPT**


DoDI 5000.2

Operation of the Defense Acquisition System

Subject: Operation of the Def

(a) DoD Directive 5000.

(b) OMB Circular A-11, *Programming Guide: P* July 1997

(c) USD(AT&L), ASD(*for Major Defense Acqu Information System (MA*

(d) DoD Directive 5025

(e) through (ww), see en

This Instruction:

1.1. Establishes a simplified a needs and technological oppor requirements, into stable, affo weapon systems and automate

1.2. Establishes a general app acknowledging that every tech any particular project or progr follow the entire process.

DoD 5000.2-R (Interim)

Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs

4 January 2001

Memorandum For Secretaries of the Military Departments

Chairman of the Joint Chiefs of Staff

Under Secretaries of Defense

Assistant Secretaries of Defense

General Counsel of the Department of Defense

Inspector General of the Department of Defense

Directors of Defense Agencies

Subject: Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs

On October 23, 2000, we issued DoD Directive 5000.1, DoD Instruction 5000.2, and a memorandum that conformed the cancelled DoD 5000.2-R with the new policies. The attached interim guidance replaces the October 23, 2000, memorandum and will be used until a final Regulation is published.

Our intent is to continue to provide Program Managers, Program Executive Officers, and their staffs with the most the current information available as they apply the new acquisition policies.

UH-60M TRL Definitions

- **TRL – 7: Assigned to components which are currently undergoing qualification testing for an Army rotorcraft program but have not been fielded on the UH-60 platform except for qualification and testing.**

- **TRL – 8: Assigned to qualified components of other fielded UH-60 systems (UH-60Q).**

- **TRL – 9: Assigned to components currently fielded on UH-60L platform.**

Near Term On-Going TRAs

Program	MS	Date
CVN(X)	MS B	Spring 03
SSGN	MS C	Nov 02
Future Combat System (FCS)	MS B	Spring 03
HIMARS	MS C	Feb 03

Recommended Component TRA Format

Outline

- Executive Summary

1.0 Purpose

- Introduction
- Approach

2.0 Program Overview

3.0 Technology Assessments (by Critical Technology Element)

- Description of the Technology
- Technology Readiness Assessment/Rationale

4.0 Conclusion

- Appendixes

TRA Lessons Learned

- Start early; guidance and standard;
- Early identification and agreement on critical technologies.
- Flexibility required – No two TRAs will be the same.
- Technology Readiness Assessment must be performed. independently from Risk Assessment.
- Regular IPRs.
- Test data the most difficult to verify.
- Working Group should include representatives from PM, Component S&T Executive, Component Acquisition Executive, and DUSD(S&T).

Discussion

- System of Systems
  - Future Combat System (FCS), CVN(X)
  - Multiple ACAT 1 systems and legacy systems
  - Evolutionary Acquisition/Block Upgrades
- Shipbuilding Programs

  " The lead ship engineering model will be authorized at MS B. Critical systems for the lead and follow ships shall be demonstrated given the level of technology maturity and associated risk **prior** to ship installation." 5000.2R
- Software Technology Readiness Levels
  - Army developed definitions (not OSD mandated)
- Chem/Bio Programs
  - Army developing appropriate TRL definitions
  - Inclusion in FY 03 update to TRA Deskbook

QUESTIONS?

ODUSD(S&T) is the responsible office for Technology Readiness Assessment

POC:

Jack Taylor
ODUSD(S&T)Weapons
Ph: (703) 588-7405
Jack.Taylor@osd.mil

BACKUP

TRL Implementation Guidance

DUSD(S&T) letter dated July 5, 2001 to DSTAG forwarded
interim guidance for implementing TRLs

- Copies to Service Acquisition Execs, PEOs and C3I
- Reevaluate within the next 18 months for impacts/adjustments

DUSD(S&T) letter dated July 12, 2001 to ODUSD(S&T) Directors

- Participate when appropriate in Working Integrated Product Teams
- Understand critical technologies identified in ACAT ID/AM programs

ODUSD(S&T)/Plans and Programs letter dated August 22, 2001

DoD 5000.2-R, Jan 4, 2001

7.5. -- Technology Maturity

Technology maturity shall measure the degree to which proposed critical technologies meet program objectives. Technology maturity is a principal element of program risk. A technology readiness assessment shall examine program concepts, technology requirements, and demonstrated technology capabilities to determine technological maturity.

The PM shall identify critical technologies via the work breakdown structure **(WBS) (see 5.3.1). Technology readiness assessments for critical technologies shall occur sufficiently prior to milestone decision points B and C to provide useful technology maturity information to the acquisition review process.**

The Component Science and Technology (S&T) Executive shall direct the technology readiness assessment **and, for ACAT ID and ACAT IA programs, submit the findings to the Deputy Under Secretary of Defense (S&T) (DUSD(S&T)) with a** recommended technology readiness level (TRL) for each critical technology**. In cooperation with the Component S&T Executive and the program office, the DUSD(S&T) shall evaluate the technology readiness assessment and, if he/she concurs, forward findings to the OIPT leader and DAB.** If the DUSD(S&T) does not concur with the technology readiness assessment findings, an independent technology readiness assessment

DoDI 5000.2, C1, Jan 4 2001

Milestone B Entrance Criteria

4.7.3.2.2.2. Technology is developed in S&T or procured from industry. Technology must have been demonstrated in a relevant environment **(reference (c) for a discussion of technology maturity) or,** preferably, in an operational environment **(using the transition mechanisms) to be considered mature enough to use for product development in systems integration. If technology is not mature, the DoD Component shall use alternative technology that is mature and that can meet the user's needs.** The determination of technology maturity is made by the DoD Component S&T Executive, with review of the determination for MDAPs by the DUSD(S&T). If the DUSD(S&T) does not concur with the determination, the DUSD(S&T) will direct an independent assessment. **To promote increased consideration of technological issues early in the development process, the MDA shall, at each acquisition program decision, consider any position paper prepared by a Defense research facility on a technological issue relating to the major system being reviewed; and any technological assessment made by a Defense research facility (reference(w)). A defense research facility is a DoD facility that performs or contracts for the performance of basic research or applied research known as exploratory development.**